

Technical Report 760

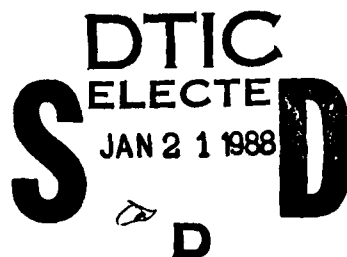
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Cooperative Learning:
A New Approach for Training
Equipment Records and Parts Specialists

Judith E. Brooks, Stephen M. Cormier, J. Douglas Dressel,
Mark Glaser, Bruce W. Knerr, and Richard Thoreson



Logistics Training Technologies Technical Area
Training Research Laboratory



U. S. Army

Research Institute for the Behavioral and Social Sciences

September 1987

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20. Abstract (Continued)

A trial implementation phase resulted in several procedural modifications, whereas the second phase was a controlled evaluation. The results showed that cooperative learning reduced academic recycling by about one half and had no effect on the test performance of most students. Students working in groups on practical exercises (PEs) made fewer errors than students working alone. Groups, however, often took longer to complete PE assignments. Normal training schedules were not disrupted by increased PE completion times or by increases in study hall attendance resulting from group rewards. Most students and instructors liked cooperative learning.

It was concluded that cooperative learning is a feasible, low-cost approach that offers cost savings through reduced student recycling. Procedural modifications that may increase achievement benefits are noted, and future research directions are suggested.

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FOREWORD

The Logistics Training Technologies Technical Area of the U.S. Army Research Institute for the Behavioral and Social Sciences conducts research into the influence of training techniques on individual soldier job performance. In support of this mission, cooperative learning was evaluated as one cost-effective training technique for improving individual achievement.

This research was conducted in the context of the Training Technology Field Activity (TTFA) at the Quartermaster School in Fort Lee, Virginia. This TTFA site and others located at Fort Knox, Kentucky; Fort Rucker, Alabama; and Gowen Field, Idaho, serve as test beds for the application of the latest training technology and for research to identify promising new training methods. The results of the research reported here indicate that cooperative learning is a feasible technique for improving soldier achievement and reducing training costs.



EDGAR M. JOHNSON
Technical Director

COOPERATIVE LEARNING: A NEW APPROACH FOR TRAINING EQUIPMENT RECORDS
AND PARTS SPECIALISTS

EXECUTIVE SUMMARY

Requirement:

The requirement was to evaluate the feasibility and usefulness of cooperative learning for improving individual soldier achievement in the Equipment Records and Parts Specialist Course.

Procedure:

Cooperative learning students in four-member groups with group reward were compared to individual learning students on measures of course achievement, task completion speed, and study hall attendance. Student and instructor attitudes toward cooperative learning were also assessed. The research was conducted in two phases. The first phase was a trial implementation to finalize the evaluation procedures, and the second phase was a formal tryout under controlled conditions.

Findings:

The results of the evaluation showed that cooperative learning reduced the usual rate of academic recycling by about one half. For students not at the bottom of the class, cooperative learning neither improved nor worsened achievement test performance. Students working in groups on practical exercises (PEs) made fewer errors than students working alone. Groups, however, took longer to complete PE assignments. Existing training schedules were not disrupted by increased PE completion times or by increases in study hall attendance resulting from group rewards. Finally, most students and instructors liked cooperative learning.

Utilization of Findings:

The research results indicate that cooperative learning is a feasible, low-cost approach that offers cost savings through reduced student recycling. The data suggest both procedural modifications for increasing achievement benefits and future research directions.

COOPERATIVE LEARNING: A NEW APPROACH FOR TRAINING EQUIPMENT RECORDS
AND PARTS SPECIALISTS

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COOPERATIVE LEARNING:
A NEW APPROACH FOR TRAINING EQUIPMENT RECORDS AND PARTS SPECIALISTS

INTRODUCTION

The Training Technology Activity (TTA) was established as a U.S. Army Training and Doctrine Command (TRADOC) office in 1983. Its mission is to improve Army training by facilitating the transfer of relevant research findings and technological developments from the laboratory to Army schools. In a joint effort between the TTA and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), four Training Technology Field Activities (TTFAs) were established to support this mission. The TTFAs are located at Fort Lee, VA (Quartermaster School); Fort Knox, KY (Armor School); Fort Rucker, AL (Aviation School); and Gowen Field, ID (Army Reserve Training Center). These sites serve as test beds for evaluating the usefulness of promising new methods and techniques for Army training. One instructional method that is currently under investigation at the Fort Lee Quartermaster School is cooperative learning. This report describes an evaluation of the cooperative learning technique as a feasible and effective approach for training the Quartermaster School's Advanced Individual Training (AIT) students in the 76C Military Occupational Specialty (MOS).

Cooperative learning has received considerable attention in recent years as a method for increasing learners' achievement levels. Students using cooperative learning are required to spend part of their class time working together in small groups and helping one another learn the course material. This contrasts with more traditional individualistic methods in which students work by themselves with only occasional help from an instructor rather than from other students. Some of the specific cooperative learning techniques that have been investigated include Teams-Games-Tournament (DeVries & Slavin, 1978), Student Teams-Achievement Divisions (Slavin, 1978), Jigsaw (Aronson, 1978), and Small-Group Teaching (Sharan & Sharan, 1976).

The results of several studies suggest that cooperative learning is more effective than individual learning for a variety of subject areas (see reviews by Sharan, 1980; Slavin, 1980, 1983). In addition, two key ingredients have been identified by Slavin (1983) as essential to the success of cooperative learning approaches in general. The first is group rewards. For cooperative learning to improve achievement, it is essential that group members be given a clear incentive for performing well as a group. In fact there is no evidence that studying in small groups is more

effective than studying individually, except in cases where a group reward structure has been employed. The second key ingredient is individual accountability, which means that each group member must demonstrate learning in order for the entire group to be successful. Thus, cooperative learning will be most effective when the group reward depends on the learning efforts of all of its members rather than, for example, on the efforts of the most motivated or the most able students.

Cooperative learning methods that rely on a group reward structure coupled with individual accountability have been successfully employed in elementary, secondary, and postsecondary classrooms. As a result, researchers within the Army's TTFA program have been keenly interested in the applicability of this instructional approach to Army training. Recently, Hagman and Hayes (1986) conducted two cooperative learning experiments with students in the MOS 76C Equipment Records and Parts Specialist Course at the U.S. Army Quartermaster School to investigate the usefulness of cooperative training for promoting individual soldier achievement.

Hagman and Hayes (1986) implemented cooperative learning during the portion of the course devoted to manual Prescribed Load List (PLL) procedures. In their first experiment, students in the cooperative learning condition worked on their practical exercises (PEs) in two- or four-member groups, while students in a control condition followed the usual approach of working individually on their PEs. At the midpoint and at the end of the PLL portion of the course, all of the students were tested individually for their knowledge of the material and received a test grade. Students were fully informed of their individual accountability for learning the material and were also informed of the type of reward system to which they had been assigned. The reward system was varied. Half of the cooperative learning students were assigned to a group reward system, and the other half were assigned to an individual reward system. Under group reward, if any one member of the group did not pass a test, all group members had to return to study hall to help the failing individual(s) restudy. Under individual reward, students were required to attend study hall only if their own individual test performance did not achieve a passing grade. Note that in this research, the term "reward" can be more accurately thought of as a negative consequence or as simply accountability. The authors' use of the term reward is maintained in this report for the sake of consistency. However, we qualify the use of this term group reward to more generally mean group accountability.

The principal finding from this experiment was that students who had completed the PEs in four-member groups under the group reward condition achieved the highest test scores and tended to require the shortest amount of time to complete tests. Consistent with previous research, cooperative learning students in the individual reward condition performed no better or even worse than students who had studied individually. The authors concluded that a cooperative training approach can improve soldiers' learning of course material and that a group reward system is necessary for the approach to be effective.

In their second experiment, Hagman and Hayes (1986) tried to determine whether the beneficial effect of group reward on student achievement under cooperative learning was due to within-group communication or to increased motivation resulting from group pressure. They did this by also providing group reward to students who worked individually. The result was that individual learning students under group reward performed no better on tests than did individual learning students under individual reward, while cooperative learning students under group reward performed the best. These findings were interpreted as support for the hypothesis that group rewards are effective primarily because they promote within-group communication, not because they motivate students as a function of peer pressure.

The Hagman and Hayes (1986) results with Army trainees are significant for several reasons. First, the findings are consistent with previous studies that have looked at cooperative learning effects in the context of other educational settings, other types of students, and other subject areas (Slavin, 1983 provides a comprehensive review). Second, the results suggest that cooperative learning is an instructional method that may lead to measurable improvements in individual student achievement in the Equipment Records and Parts Specialist Course. Third, this approach appears to be one that can be readily implemented at little or no additional cost to the school in terms of soldier training time, staff hours, and financial resources. As a response to the Hagman and Hayes (1986) study, the current project was initiated to more thoroughly investigate the benefits, costs, and feasibility of implementing cooperative learning as an instructional technique in this course.

The objective of the current project was to conduct a formal tryout of cooperative learning in the Equipment Records and Parts Specialist Course to more precisely determine its effect on test performance, PE performance, and study hall attendance. It was also of interest to assess student and instructor attitudes toward this new technique. Cooperative learning was implemented throughout most of the course, beginning with

manual PLL procedures. Students who worked the PEs cooperatively in groups with a group reward system were compared with students in a control condition who followed the typical procedure of working PEs individually. In the cooperative condition, a constant group size of four was implemented based on the Hagman and Hayes (1986) findings. Comparisons between the two learning conditions on measures of achievement test and PE performance permitted an evaluation of the effectiveness of cooperative learning for improving course achievement. Student and instructor attitudes toward cooperative learning and the study hall attendance data helped to determine the feasibility of implementing a cooperative learning approach.

The tryout was conducted in two phases. The first phase involved only two classes of students, with one class assigned to each of the two instructional conditions. The major objectives of Phase 1 were to identify any unforeseen problems associated with conducting a valid tryout of cooperative learning and to make necessary modifications to training and evaluation procedures prior to Phase 2. The Phase 2 tryout, which involved a total of six classes and which incorporated lessons learned from Phase 1, provided a valid indication of the effects of cooperative learning. Both phases are described in the following sections.

PHASE 1 TRIAL IMPLEMENTATION

Method

Course Description

The Equipment Records and Parts Specialist Course is a 9-week, 4-day course designed to train soldiers in MOS 76C. The 76C is a parts clerk who is responsible for supplying the mechanics with requested parts and for having a regulated amount of parts either on hand or on order at all times. These responsibilities are performed in any of four duty positions and require the completion or annotation of numerous forms according to procedures detailed in multiple technical manuals and periodic updates.

The course is divided into nine functional sections called annexes, labeled A through I. The first and final two annexes (A, H, and I) differ in format and function from the rest of the course. Annex A provides an MOS orientation, introduces the soldier to Army Master Data File (AMDF) procedures, and allows individual hands-on equipment manipulation of a microfiche reader and microfiche. Annex H is a comprehensive PE and field training exercise that provides extensive hands-on practice on the

previously learned tasks of Annexes B through G. Finally, Annex I is the end-of-course comprehensive test which determines if the individual student graduates from the course.

Annex B (Manual PLL), Annex C (Automated PLL), Annex D (Manual Shop Stock), Annex E (Automated Shop Stock), Annex F (The Army Maintenance Management System or TAMMS), and Annex G (Shop Clerk) comprise the core of the course and follow a common instructional format. The typical sequence of instruction is as follows. First, an instructor provides lecture and demonstration on the performance of a given task with the aid of an overhead projector. The class then practices the task by completing a PE, which is a set of problems. The standard procedure is for each student to work individually and independently to complete the PE. Upon completion, the student takes the PE to the instructor who quickly inspects the solutions and discusses any errors with the student. After all PEs have been inspected, the instructor stands before the class and clarifies any area in which the students had difficulty. The cycle is repeated for each block of instruction within the annex. The annex concludes with a written test which the student must pass (either initially or upon retesting) in order to proceed to the next annex where the lecture-PE cycle is continued.

The Phase 1 trial implementation of cooperative learning focused primarily on Annexes B through G. A decision was made to exclude Annex A because its equipment orientation provided unique implementation problems. In Annex H, students in the cooperative learning condition had an opportunity to work in groups if they so desired. However, unique scoring problems in this particular training environment precluded the implementation of the same cooperative learning procedures in Annex H that were employed in Annexes B through G. Finally, for reasons of individual accountability, group participation did not apply to the Annex I exam.

Subjects and Design

A double class of 71 AIT students enrolled in the Equipment Records and Parts Specialist Course participated in the Phase 1 tryout.¹ The incoming students were assigned to classes so that the proportion of students belonging to each service component was nearly the same for the two classes. Although students were matched on this characteristic, their assignment to classes was otherwise random. One class was then randomly assigned to the cooperative learning condition, and the other was assigned to the individual learning or control condition. Initial enrollments for the cooperative learning and individual learning classes were 35 and 36 students, respectively. A different team of instructors was randomly assigned to each class.

Procedure

All of the 76C course instructors who were involved in the cooperative learning tryout were briefed by ARI researchers about the tryout objectives, procedures, and data collection requirements. In addition to an oral presentation, each instructor received a written Instructor's Guide that provided explicit guidance concerning the tryout procedures associated with each learning condition. Special data collection forms and other materials that the instructors would need for data recording were given to the instructors at this time. Written directions and sample data collections forms that had been partially filled out for illustrative purposes were also provided to ensure that all instructors fully understood the data recording requirements.

At the start of Annex B, the instructor team for the cooperative learning class divided the 35 students into nine study groups using an alphabetical assignment procedure. Eight of the groups had four members, and one group had three members. Students were instructed to work together in their groups on all PE assignments and to arrive at their answers as a team. To facilitate group interaction, the desks in this classroom were clustered by groups. Each individual student had his or her own PE booklet for recording the answers that had been agreed upon by the group. If a consensus could not be reached by the group on one or more questions in the PE, the group could request and receive assistance from an instructor. Any groups that could not complete the PE within the amount of time allotted in the Program of Instruction (POI) were required to attend the next study hall to finish their work.

The testing procedures for the cooperative learning class did not vary from normal school procedures and were identical to those of the individual learning class. All testing was conducted individually at the scheduled time according to the POI. An independent testing team of instructors was assigned to perform the duties of test administration and scoring.

A group reward (accountability) structure was employed in the cooperative learning condition so that the members of a group were rewarded as a group rather than as individuals. The reward, which was the same as that used by Hagman and Hayes (1986), concerned remedial study hall attendance following each annex test. Group reward meant that all members of a group could proceed to the new material without having to attend a remedial study hall, only if all members had passed the test (i.e., had achieved a score of 85 or higher). If one or more members failed the end-of-annex test, all group members were required to attend

remedial study hall and help the failing individual(s) study for the retest. In contrast, the traditional or individual learning classroom operated under the individual reward system that is currently practiced at the school. Under individual reward, a student was sent to study hall only if his or her own test performance was failing (below 85).

In the cooperative learning classroom, the ideal size of each study group was established and maintained at four members. However, because of normal fluctuations in class enrollment and variations in class size, group sizes of three and five were also allowed. When students were recycled into the cooperative learning classroom, an effort was made to randomly assign them to existing groups, keeping within the size limits of three to five and creating groups of four when possible. When students were dropped from the cooperative learning class, the groups that lost members were not necessarily reassigned unless, for example, the group had been reduced to only two members.

A group learning procedure was routinely used for all PEs in the cooperative learning classroom up until the Annex H comprehensive PE. In this annex, the PE work could not practicably be scored for either classroom. This prevented a comparison between classes with respect to performance. However, Annex H did provide an opportunity in the cooperative learning class to gauge whether students had a preference for working in groups or working the PE individually. Thus, at the start of Annex H, each student in the cooperative learning classroom was asked to fill out a confidential ballot to indicate his or her preference for either cooperative or individual learning. If a majority of the members of a group preferred to continue working as a group, the group was allowed to work together throughout the comprehensive PE. If only half or fewer than half of the members of a group preferred the group method, the group was disbanded to permit individual work. The ballots were kept by researchers to later record and tabulate the preference data.

At the end of the course, questionnaires were used to gather additional information on students' and instructors' attitudes and perceptions concerning cooperative learning. Each student and instructor in the cooperative learning classroom was asked to fill out a confidential questionnaire that was designed to assess likes and dislikes as well as perceived advantages and disadvantages of a cooperative learning implementation.

The individual learning class served as the control condition and did not deviate from the instructional procedures that are ordinarily followed in the 76C course. All PEs were worked individually by the students with assistance from an instructor if needed. Individuals who could not

complete the PE during the normally scheduled time attended study hall to finish the exercise. Testing was conducted individually, as usual. The only change implemented in the individual learning class was the requirement to collect and record detailed data pertaining to PEs, tests, and study hall. A complete summary of all of the Phase 1 tryout data that were collected is given in Table 1.

Table 1. Types of Data Collected During the Phase 1 Trial Implementation

BACKGROUND DATA (Both Classes)

General Technical (GT) Score from the ASVAB
Clerical (CL) Score from the ASVAB
Service Component

ACHIEVEMENT TEST DATA (Both Classes)

Annex Test Scores
Annex Test Completion Times
End-of-course test (EOCT) Score
EOCT Completion Time

PE PERFORMANCE DATA (Both Classes)

PE Errors
PE Completion Times

RECYCLE DATA (Both Classes)

Number of Academic Recycles
Annex Test Scores of Recycled Students

STUDY HALL DATA (Both Classes)

Number of Sessions
Number of Students Attending
Number of Instructors Monitoring
Duration of Study Halls

ATTITUDE/OPINION DATA (Cooperative Learning Class Only)

Student Preference for Group versus Individual Work during Annex H
Instructor Questionnaire Responses
Student Questionnaire Responses

Results and Conclusions

Lessons Learned

The initial tryout phase proved valuable for identifying unanticipated problems associated with data collection and for suggesting changes in the tryout procedure that were needed to ensure interpretable data. The following are the principal lessons that were learned from Phase 1: a) differences in teaching style between the two instructor teams were greater than expected and seriously hampered data interpretation; b) a surprisingly intense spirit of competition developed between the instructor teams and most likely had an influence on student achievement data in both classes; c) instructors participating in the tryout needed stricter guidelines pertaining to schedule adherence and the use of classroom time; d) a common set of criteria for sending students to study hall needed to be clearly defined and agreed upon by instructors in both classes; e) initially there was no established procedure that would allow cooperative learning instructors to change the composition of a group without invalidating the group reward structure; f) the classroom seating arrangement designed to facilitate cooperative learning during the PEs was found to interfere with students' ability to see and attend to platform instruction; g) frequent communication among ARI researchers, the 76C Branch Chief, and participating course instructors was found to be essential to prevent and clear up misunderstandings related to tryout procedure; and h) students in the cooperative learning class appeared uncomfortable with group work at first and seemed to need a warmup period.

Tryout Modifications

Table 2 provides a summary of all of the lessons that were learned in Phase 1 and of the corresponding steps that were taken to improve the cooperative learning tryout procedure. To the extent possible, tryout procedures were modified during Phase 1 as problems were encountered. For example, the seating arrangement in the cooperative learning classroom was changed as soon as this need became apparent. Procedural guidelines were also developed or clarified for instructors as needed while the trial implementation progressed. Certain other modifications to the tryout procedure, such as creating a warmup period for the cooperative learning groups, could not be implemented until the Phase 2 tryout. Although the various modifications were identified and implemented at different times, all necessary changes were in place by the start of the formal Phase 2 tryout.

Table 2. Lessons Learned During Phase 1 and the Resulting Tryout Modifications.

LESSON LEARNED	RESULTING MODIFICATION
Differences between instructor teams were substantial.	The number of classes included in the Phase 2 tryout was increased to 3 per learning condition.
A strong competitive spirit existed between instructor teams.	During instructor training, researchers stressed that instructors were not being evaluated and deemphasized the comparisons between classrooms.
Instructor teams differed in terms of schedule adherence and the use of classroom time.	Instructors were fully informed of the need to adhere to the regular class schedule.
Instructor teams applied different criteria for sending students to study hall.	Criteria were defined and agreed upon by all instructors in advance.
Cooperative learning instructors expressed a strong desire to change group composition and did so in ways that invalidated the group reward system.	Instructors were given the flexibility to make group changes plus clear guidelines for how and when to make the changes.
Seating intended to facilitate group work interfered with platform instruction.	Students were seated in rows facing the instructor. At the start of a PE, half of the students turned around to face group members.
Frequent communication between instructors and researchers was necessary to solve problems and clarify procedures.	Researchers were scheduled to be in the classrooms approximately 4 days each week to monitor data collection and coordinate the research.

Students needed warmup time before working together on PEs.

Group membership was determined during Annex A so that students could get acquainted with group members prior to doing group work in Annex B.

Data Interpretation

Clearly the most important Phase 1 results were the changes that were made to the tryout procedure in preparation for Phase 2 data collection. Although several kinds of data were available from Phase 1, including performance data, the pilot nature of this phase seriously hampered data interpretation. For this reason, none of the Phase 1 data were statistically analyzed or interpreted.

PHASE 2 FORMAL TRYOUT

Phase 2 of the project was a formal tryout of cooperative learning that occurred during the period 4 September through 9 December 1986. This tryout was similar to the Phase 1 trial implementation but studied a larger number of 76C students under conditions of more rigorous experimental control. The goals of Phase 2 were to precisely determine: a) the effect of cooperative learning on 76C course performance; b) the impact of this new approach on training hours; and c) the reactions of students and instructors to cooperative learning as an instructional technique.

Method

Course Description

By the start of Phase 2, several alterations from Phase 1 had occurred in the course itself to reflect an organizational restructuring at the school. In brief, the course was reorganized into the two distinct levels in which the 76C soldier must be knowledgeable (unit/organization and direct support). A major impact of this change was a resequencing of Annexes B through G such that Annexes B, C, and F (topics pertaining to unit/organization level) were taught first, followed by Annexes D, E, and G (topics pertaining to direct support level). A second major course change brought about by the reorganization was the assignment of separate teams of instructors to these two portions of the course. One team of

instructors covered PLL Manual, PLL Automated, and TAMMS (Annexes B, C, and F). A second team of instructors then took over to instruct students in Shop Stock Manual, Shop Stock Automated, and Shop Clerk (Annexes D, E, and G). One other change resulting from the reorganization was the elimination of separate testing teams to conduct test administration and scoring. Under the new organization, instructors administered and scored the tests for their own classes. There were some very minor changes to the course training schedule. The POI, however, was the same as that used in Phase 1.

Subjects and Design

Six classes of 76C students were identified for Phase 2 participation. As a pair of classes entered the school, one class was randomly assigned to the cooperative learning condition, and the other was assigned to the individual learning or control condition.² The three cooperative learning classes had enrollments of 52, 44, and 40 students; the three individual learning classes had enrollments of 44, 45, and 39 students.³ Total participation in Phase 2 was therefore 264 students.

Efforts were made, when possible, to ensure that classes in the two learning conditions were similar in the proportion of students belonging to each service component. With this exception, all incoming students were randomly assigned to classes. The assignment of instructor teams to classes was also random.

Procedure

The Phase 2 tryout of cooperative learning was similar in procedure to the Phase 1 effort. It incorporated a few changes, though, as a result of both the course reorganization and the lessons that had been learned from the trial implementation. The most significant procedural change was that cooperative learning study groups were initially formed during Annex A rather than at the start of Annex B. By about the third day of the course, Annex A instructors assigned students to four-member groups such that each group had a uniform mixture of high, average, and low performers, based on instructor assessment of students' performance-to-date. At this time, students were informed of their group membership and of the cooperative learning approach that would be employed in the course beginning with Annex B. Students were also encouraged to sit near their groupmates for the remainder of Annex A and to get acquainted with them in preparation for later teamwork. A class roster indicating the student groupings was then forwarded to the instructors who would receive the class next for Annexes B, C, and F.

As in Phase 1, all 76C instructors involved in the project were briefed by researchers about the nature of the project and their responsibilities as tryout participants. Many more teams of instructors were involved in Phase 2, however, due to the introduction of grouping in Annex A and to the new school requirement for separate instructor teams in the unit/organization level and the direct support level portions of the course. Appropriate instructor briefings were therefore extended to Annex A instructors, Annex B, C, F (unit/organization level) instructors, and Annex D, E, G (direct support level) instructors. In most cases, instructors were briefed just two or three days before they actually received the class to avoid the problem of last-minute instructor reassignment and to minimize forgetting.

The briefing presented to the instructors who taught Annexes B through G was modified slightly from Phase 1 to prevent some of the problems that had been experienced in the first implementation. Specifically, the fact that instructors were not being evaluated for their teaching effectiveness was emphasized to minimize competition between instructors assigned to the two learning conditions. The need for adhering to the class schedule and the need for consistent study hall attendance criteria were also stressed to avoid the kinds of unwanted differences between learning conditions that had been observed in Phase 1. Instructors for the cooperative learning classes were also given explicit rules for when and how to change the composition of groups if a change was considered necessary or prudent. Finally, the cooperative learning instructors were cautioned not to interfere with or dictate how the study groups function, other than to ensure that the members discussed and agreed on PE solutions. A detailed Instructor's Guide that was given to each instructor can be seen in Appendix A.

As in Phase 1, cooperative learning groups worked together on all PEs from the start of Annex B through the end of Annex G. The group learning procedures were the same as in Phase 1 with the exception of the classroom seating arrangement. Since the first effort had shown that clustering desks by groups could interfere with the teaching process during platform instruction, desks were not clustered at any time during Phase 2. Students were seated in rows in such a fashion that when half of the students turned their chairs around, they would be facing their groupmates. This arrangement afforded maximum visibility during platform instruction while minimizing furniture movement and seating time at the start of a PE.

A slight change from Phase 1 occurred in the voting procedure for Annex H. As before, cooperative learning students completed confidential ballots to indicate their preference for group or individual work during the Annex H comprehensive PE. However, this time the votes were tallied

for the class as a whole rather than by groups. If a majority of the class voted to continue group work, all groups in the class remained intact. If half or more of the students in the class wanted to work individually, all of the groups were disbanded to permit individual work. This slightly different procedure was adopted in response to the preference of some instructors for uniformity in the classroom and was also deemed more efficient. As in the trial effort, only the vote count was tallied; no performance data were recorded for this annex.

All of the types of data collected in Phase 1 were also collected in Phase 2. In addition, the final course average of each student who completed the course was obtained from student records as a supplemental measure of course performance. Table 3 provides a complete summary of the data that were collected along with a rationale for the inclusion of each measure.

Table 3. Summary of Phase 2 Data Collection and Rationale

DATA	RATIONALE
Background Data ASVAB GT Score ASVAB CL Score Service Component	To determine whether students in the two learning conditions differed in critical aptitude and background characteristics and, if so, to be able to control for such differences statistically; to investigate whether cooperative learning effects depend on student aptitude
Achievement Test Data Annex Test Scores Annex Test Completion Times End-of-course Test (EOCT) Scores EOCT Completion Times	To assess the effect of cooperative learning on task performance (both accuracy and completion time) at different points in the course and with different materials

PE Performance Data	To determine how group PE work affects
PE Errors	the accuracy and speed of PE solutions;
PE Completion Times	in particular, to determine whether groups
	require more time to complete PEs than is
	currently scheduled
Recycle Data	
Number of Academic Recycles	To evaluate the effect of cooperative
Annex Test Scores of	learning on academic recycle rate; to
Recycled Students	compare the test performance of recycled
	students in the two learning conditions
Study Hall Data	To evaluate the effect of cooperative
Number of Sessions	learning with group study hall reward
Number of Students Attending	on the number of students attending
Number of Instructors	study hall and on study hall time and
Monitoring	staffing requirements
Duration of Study Halls	
Attitude/Opinion Data	To make a preliminary assessment of
Student Preference for	student and instructor attitudes toward
Group vs Individual Work	group learning; to identify specific
During Annex H	dislikes or problems associated with the
Student Questionnaires	group approach that would make implementation
Instructor Questionnaires	unwise or unfeasible; to identify possible
	avenues of procedural modification that
	should be investigated

Entry-level pretests to determine what students knew prior to training were not administered as part of the tryout for two reasons. First, there were no tests available that could be used as pretests, nor were there resources to develop test materials. Second, the training schedule did not permit the estimated 14 hours of class time that would be needed for pretesting all annexes. The elimination of pretests was indeed considered necessary to keep the tryout's impact on instructor and student schedules to a minimum.

There were no a priori reasons, however, to believe that students were knowledgeable of MOS 76C job procedures prior to training. Most of them had just completed basic training and had no previous AIT experience.

The tasks themselves are highly specialized and not likely to have been encountered in a civilian environment. Moreover, the ability to randomly assign students to conditions while matching on service component allowed us to assume that any preexisting knowledge or skills were evenly distributed over the two conditions.

Results

Background Data

Background data consisting of service component, ASVAB GT scores, and ASVAB CL scores were available for most of the students who participated in the tryout. These data were used to identify student characteristics and to determine whether there were significant preexisting differences between learning conditions that should be taken into account when analyzing and interpreting the course performance data. In this and in all subsequent analyses, an alpha level of .01 was used to evaluate the significance of effects unless otherwise noted.⁴

First, analysis of the service component data verified that efforts to match students on this characteristic had indeed resulted in nearly identical proportions of regular army, national guard, and army reserve students in the two learning conditions. Approximately 61% of the students in both conditions were regular army, 27% were national guard, and 12% were army reserve.

The ASVAB data were analyzed next to assess whether there were any differences between groups in their aptitude for learning the 76C course material. The mean GT score was found to be 107.32 (SD = 8.88) for the cooperative learning students and 106.37 (SD = 8.95) for the individual learning students. The CL score means were 108.48 (SD = 9.69) for the cooperative learning condition and 106.16 (SD = 9.38) for the individual learning condition. Separate *t*-tests performed on the GT and CL scores indicated that the differences between the two conditions were not statistically significant for either measure.

Finally, separate 2 (learning condition) x 3 (class) analyses of variance (ANOVAs) were performed on the GT data and on the CL data to determine whether differences among the three classrooms were similar for the two learning conditions. The learning condition x class interaction was not statistically significant for either the CL or the GT analysis, indicating that between-class differences in GT and CL scores were comparable for the cooperative and the individual learning conditions. The main effect of class was also not significant. On the basis of these

analyses, it was concluded that students in the two learning conditions and in the separate classrooms were not different at the outset in aptitude for learning the course material.

Academic Recycle Rate

The academic recycle rate was examined as one basis for comparing the performance of students in the two conditions. Out of 136 students enrolled in the cooperative learning classes, 6 (4.4%) were recycled for academic reasons; 14 (10.9%) of the 128 individual learning students were academically recycled. This result shows that the overall recycle rate for the individual learning students was more than twice as high as the rate for the cooperative learning students. The data presented in Table 4 also show that this difference in rate was consistently obtained for all three pairs of classes.

Table 4. Number and Percent of Students Academically Recycled From Each Pair of Classes

Class Pair	<u>Cooperative Learning</u>		<u>Individual Learning</u>	
	Number Recycled	% of Class	Number Recycled	% of Class
Pair #1	1	(1.9%)	2	(4.5%)
Pair #2	2	(4.5%)	5	(11.1%)
Pair #3	3	(7.5%)	7	(17.9%)
Overall	6	(4.4%)	14	(10.9%)

The recycle data were further examined to determine the characteristics of students who were academically recycled. To assess whether recycling was related to learning aptitude, a correlation was computed between students' CL scores and the occurrence or nonoccurrence of academic recycling. It was found that recycling correlated only .06 with learning aptitude, when all students in the tryout were considered as

a single group. Separate correlations were also computed for each learning condition. For the cooperative learning condition, the correlation was found to be .14, and in the individual learning condition, the correlation was $-.02$. The correlation results suggest that academic recycling is not related to a student's aptitude score, particularly in classes that follow the individual learning method. That is, high-aptitude and low-aptitude students are about equally likely to be academically recycled in the 76C course. The aptitude scores of all recycled students are shown in Table 5.

Table 5. Clerical Aptitude Scores of the Recycled Students

<u>Learning Condition</u>	
Cooperative	Individual
96	96
96	96
104	97
104	98
111	100
111	101
	102
	102
	103
	110
	116
	120
	121
	132

Finally, a comparison was made between recycled students in the two learning conditions on their performance in the course up until the point when recycling occurred. The test average of each recycled student in the cooperative and individual learning conditions was calculated, and a mean was determined for each condition. The mean test average was found to be

84.50 for recycled cooperative learning students, and 77.85 for recycled individual learning students. That is, recycled students who had learned under the group approach were generally performing at a higher level than were the recycled students in the traditional classes. Given the small number of recycled students, however, one cannot reasonably determine whether this difference in performance was statistically or practically significant.

Achievement Test Scores

Annex Test Scores. Annex achievement test scores were analyzed to determine whether cooperative learning resulted in better test performance for those students who completed the course on schedule, without being recycled. A total of seven annex achievement tests were administered to students throughout the course. One test was administered midway through Annex B; the remainder were end-of-annex tests administered at the completion of Annexes B, C, F, D, E, and G. A set of seven test scores, representing the percent of items answered correctly on each test, was available for each student who stayed with the course on schedule. An analysis was planned to assess whether students under the cooperative learning method achieved higher test performance than students under the individual learning approach on any or all of these test occasions.

Before performing the statistical analysis, a decision was made to exclude the Annex E test data. This was due to the fact that cooperative learning had not been fully implemented during Annex E for two out of the three cooperative learning classes. An unanticipated shortage of Annex E PE materials had forced instructors either to substitute extended platform instruction in lieu of doing PEs and/or to devise their own informal PE materials. Although both individual and cooperative learning classes were affected by the shortage of materials, different instructors handled the situation differently. More importantly, most of the cooperative learning students either did not have an opportunity to work on PEs in groups or did not participate in group work to the same extent as they would have under normal circumstances.

The remaining six annex test scores of all tryout participants who completed the course on schedule were submitted to a 2 x 6 mixed ANOVA. The between-subject variable was learning condition (cooperative vs. individual), and the within-subject variable was the annex test (B1, B2, C, F, D, and G). Because individual classes were not of interest, the data from the three classes within a learning condition were combined in this and in subsequent analyses. The result was no significant difference in overall test performance for students in the two conditions. There was, however, a significant learning condition x annex interaction, $F(5,$

1170) = 6.33, MSe = 22.96. Further analysis of this interaction, using the Tukey statistic to compare the means at each test point, revealed that the differences between the cooperative and individual learning students were significant only at B1. On this first exam, the mean of the individual learning students was significantly higher than the mean of the cooperative learning students. At all other test points, the means were not reliably different (Tukey critical range = 1.64, $p = .01$). The means and standard deviations for each condition over the six test points are shown in Table 6.

Table 6. Annex Test Score Means and Standard Deviations for the Cooperative and Individual Learning Conditions

	Annex						
Learning Condition	B(1)	B(2)	C	F	D	G	Overall
Cooperative (N=127)							
Mean	93.05	93.06	90.89	92.64	93.79	93.38	92.80
SD	7.27	6.06	6.38	5.83	5.63	5.34	
Individual (N=109)							
Mean	96.00	92.16	89.82	93.39	92.95	94.40	93.12
SD	5.15	5.62	5.58	4.99	5.73	3.88	
Overall	94.41	92.64	90.39	92.98	93.40	93.85	

The analysis of the annex test scores suggests that the cooperative learning approach did not improve the test performance of students who completed all annexes of the course on schedule. The cooperative and individual methods resulted in nearly equivalent test performance throughout the course, except for the superior performance of individual learning students on the first B Annex exam.

Final Course Averages. A final course average was also available for each student who completed the course. This indicator of overall course performance is a weighted average of the annex test scores and serves as the criterion by which each student's class standing is determined. The weights reflect the relative importance assigned by the school to each annex of the course. Students in the two learning conditions were compared to determine if cooperative learning had any impact on this measure of course achievement.

The resulting means were 93.71 (SD = 3.14) for the cooperative learning students and 93.50 (SD = 2.94) for the individual learning students. The difference in these means as evaluated by a t-test was not statistically significant. This result suggests that there was no overall difference between students in the two learning conditions on the final course averages that they achieved.

End-of-Course Test (EOCT) Scores. The EOCT is a comprehensive test administered at the end of the course (Annex I). It consists of two parts, A and B, that test students' knowledge of unit/organization level and support level procedures, respectively. Each student receives a Part A score, a Part B score, and a composite EOCT score that is simply the sum of the two components.

The EOCT composite scores were analyzed first to assess whether students in the cooperative learning classes achieved higher scores overall on the comprehensive test than did students in the traditional classes. The means for the two learning conditions, collapsing over classes, were 90.00 (SD = 7.92) for the cooperative learning students and 90.65 (SD = 4.29) for the individual learning students. A t-test indicated that this slight difference between the means did not approach statistical significance.

The component scores were then examined in a 2 (learning condition) x 2 (test component) ANOVA to check for any possible group differences on Part A, Part B, or both. The result was that students in the two conditions performed nearly identically on the two EOCT components, and indeed the condition x component interaction did not approach significance. The results of this and the first EOCT analysis suggest that cooperative learning had no adverse effect on overall comprehensive test performance nor on either component of the test.

Test Performance and Aptitude. A final set of analyses were performed on the annex test scores to investigate the possibility that cooperative learning may have benefited at least some of the students who

completed the course on schedule, particularly those of relatively low aptitude. By dividing students into groups of high and low aptitude, it was possible to assess whether low-aptitude students in the cooperative learning classes achieved higher test performance than low-aptitude students in the traditional learning classes at any point in the course. By the same token, it was also possible to examine whether the performance of high-aptitude students in group learning classrooms had actually suffered as a result of the new technique, a suggestion that had been offered by some students and school personnel.

Two aptitude measures, ASVAB GT scores and ASVAB CL scores, were available as a basis for identifying high- and low-aptitude students. These two measures were highly correlated at .81. In order to select one of them, a correlational analysis was performed to determine which score was more highly related to 76C course achievement, using final course average as a global achievement measure. The correlation between CL and final course average was found to be .48, compared to a slightly lower correlation of .42 between GT and final average. The CL scores were therefore used to divide the students in each learning condition into groups of high, average, and low aptitudes. The middle third of each group (students of average aptitude) were dropped to allow analysis of only those students at the extreme ends of the aptitude continuum.

The annex test scores of high- and low- aptitude students were submitted to a 2 (learning condition) x 2 (aptitude) x 6 (annex test point) mixed ANOVA. The result was that the effect of most interest, the aptitude x learning condition interaction, did not approach significance. That is, the difference in test performance between high- and low-aptitude students was as pronounced for the cooperative learning condition as it was for the individual learning condition. The actual means are available for inspection in Table 7. The three-way interaction of aptitude, learning condition, and annex was also not significant, suggesting that regardless of the annex test point, the differences in performance between high- and low-aptitude students were similar for the two learning conditions. It appears that cooperative learning neither benefited low-aptitude students nor placed high-aptitude students at a disadvantage.

Table 7. Mean Annex Test Scores and ASVAB Clerical (CL) Scores of High- and Low-Aptitude Students in the Cooperative and Individual Learning Conditions

Aptitude	Learning Condition	
	Cooperative	Individual
High	Test mean = 94.92 CL mean = 120.70 (N = 40)	Test mean = 95.48 CL mean = 117.58 (N = 36)
Low	Test mean = 90.91 CL mean = 99.60 (N = 40)	Test mean = 91.53 CL mean = 97.44 (N = 36)

Achievement Test Completion Times

Annex Test Completion Times. The annex test time data consisted of the time in minutes that students required to complete each of the annex achievement tests. Annex E test completion times were eliminated from analysis at the outset for the same reason that Annex E test scores were not analyzed (i.e., cooperative learning had not been fully implemented during Annex E). Moreover, analysis of the annex test times was further hampered by an extensive amount of missing or uninterpretable data. Half or more of the D and G Annex time data were either missing or uninterpretable for the cooperative learning classes, and all of the B1 time data were missing for one of the individual learning classes. The most complete set of data available for analysis consisted of the completion times for annex tests B1, B2, C, and F from 76 cooperative learning students and 66 individual learning students. These times were submitted to a 2 (learning condition) x 4 (annex test points) mixed ANOVA to determine whether the cooperative learning approach resulted in faster test completion times on any or all of these test occasions.

The result of the analysis was a significant main effect of learning condition, $F(1, 140) = 19.76$, $MSe = 2,704.26$. The overall mean completion time of cooperative learning students (155.32 minutes) was significantly longer than the overall mean completion time of students in the traditional classes (135.87 minutes). Moreover, the faster test performance of individual learning students was consistent over all four test occasions. The available data therefore suggest that, at least for the first half of the course, cooperative learning actually resulted in a decrement in task performance speed under testing conditions.

EOCT Completion Times. Whereas the annex test times had provided a measure of test speed only in the first half of the course, the EOCT times provided an indication of test speed at the end of the course. To provide a reasonable basis for comparing the conditions on test completion speed over time, only those students included in the previous annex test time analysis were compared on EOCT speed. The EOCT times were calculated as a composite of both the Part A and the Part B times, since not all instructors had recorded separate EOCT component times.

The result of a t-test performed on the EOCT completion times revealed that cooperative learning students took significantly less time than individual learning students to complete the course comprehensive test, $t(140) = 7.99$. The mean times for the EOCT and for the previous annex tests are presented together in Table 8. The data imply that cooperative learning students initially required more time to perform tasks in a test situation, but by the end of the course actually required less time.

Table 8. Mean Test Completion Times in Minutes for Students in the Cooperative and Individual Learning Conditions

Learning Condition	Test				
	B1	B2	C	F	EOCT
<hr/>					
Cooperative (N=76)					
Mean	114.96	201.01	132.33	172.96	256.99
SD	23.20	36.47	25.87	31.60	52.70

Individual
(N=66)

Mean	94.42	176.82	112.92	159.30	339.00
SD	36.17	42.17	33.11	39.56	69.35

PE Errors

The raw PE error data consisted of the number of errors made by each student on each PE. In the traditional classes, each student's error score was based on his or her own individual work. In the cooperative learning classes, students worked the PEs in groups, and all of the members of a group received the same PE error score.

In each of Annexes B through G, a set of 4-10 PEs was completed. Since the annexes varied in the number of scheduled PEs, the error data were averaged within a given annex to facilitate the comparison of error rates at various points in the course. For every annex, then, a mean PE error score was computed for each student. (Because there were two identifiable sets of PEs in Annex B, students had two mean PE error scores for this particular annex.) These means served as the dependent measure in the PE error data analysis.

Error data from two of the annexes were excluded prior to performing an analysis. In Annexes D and E, problems related to the PE materials themselves prevented legitimate comparisons between learning conditions on PE error scores. In Annex D, an unanticipated delay in the distribution of updated PE materials required that an old comprehensive PE be used. Because different instructors took different approaches to selecting and dividing this material, classes were not comparable in the number or even the content of the PEs that had been completed. A similar delay of new materials affected Annex E such that two of the classes did not have any PE materials to work with. Moreover, some instructors refused to use the old Annex E PE materials that were available because of numerous content errors.

The remaining PE error scores from Annexes E, C, F, and G were submitted to a 2 x 5 mixed ANOVA with learning condition as the between-subject variable and annex as the within-subject variable. The result of this analysis was that learning approach did have a significant overall effect on the number of PE errors, $F(1, 228) = 223.21$, $MSe = 32.64$. Students under the group learning approach made

substantially fewer errors than did students who had worked the PEs individually. The means in Table 9 show that the reduction in PE errors for the cooperative learning condition occurred in all five sets of PEs. Pairwise comparisons between learning conditions at each point indicated that all differences were significant, Tukey critical range = 1.05, $p = .01$. The means also show that the difference in PE errors was especially large during the second half of B Annex due to a high number of errors in the control condition. In general, what these results suggest is that cooperative learning may be a very effective technique for substantially reducing the number of PE errors made by students throughout the course.

Table 9. Mean Number of PE Errors for Students in the Cooperative and Individual Learning Conditions

	Annex					
Learning Condition	B1	B2	C	F	G	Overall
Cooperative (N=127)						
Mean	0.89	2.73	1.46	1.56	2.68	1.86
SD	0.78	1.72	1.19	1.59	2.94	
Individual (N=103)						
Mean	5.59	13.87	5.42	5.23	4.51	6.93
SD	4.22	8.99	3.73	3.29	3.41	
Overall	3.00	7.72	3.23	3.20	3.50	

PE Completion Times

PE completion times refer to the number of minutes needed by each student to complete each PE. In the individual learning condition, the times reflected the pace of students working individually, whereas times in the cooperative learning condition reflected the pace of students working the PEs in groups.

The first step in analyzing the completion time data was to determine mean completion times for the PEs within each annex. As explained in the presentation of the PE error data, the means allowed a comparison of completion times across the different annexes of the course. The time data for Annexes D and E were partially missing or uninterpretable and therefore excluded from the analysis (see the preceeding discussion of the PE error data for a fuller explanation). The remaining mean completion times were analyzed in a 2 x 5 mixed ANOVA with learning condition as the between-subject variable and annex as the within-subject variable.

One result of this analysis was a significant main effect of learning condition, $F(1, 229) = 35.69$, $MSe = 391.21$. The overall mean completion time for the cooperative learning students (56.27 minutes) was significantly longer than the overall mean completion time for the individual learning students (49.27 minutes). There was also a significant learning condition x annex interaction, $F(4, 916) = 44.78$, $MSe = 86.50$, indicating that the completion time differences varied by annex. The interaction can be examined in Table 10 which shows the mean completion time for each learning condition at each annex.

Table 10. Mean PE Completion Times in Minutes for Students in the Two Learning Conditions at each Annex, and Mean Scheduled Times from the POI

Learning Condition	Annex					Overall
	B1	B2	C	F	G	
Cooperative (N=128)						
Mean	43.32	77.45	42.88	49.30	68.39	56.27
SD	9.19	15.96	11.72	10.77	12.04	

Individual (N=103)						
Mean	42.75	61.39	31.21	38.91	72.10	49.27
SD	10.11	18.13	5.59	7.36	14.84	
<hr/>						
Overall	43.06	70.29	37.68	44.67	70.05	
<hr/>						
Mean POI						
Scheduled Time	80.00	78.57	55.56	82.14	75.00	
<hr/>						

Inspection of the Table 10 means shows that the cooperative learning groups took longer to complete the PEs in all but the last annex. The Tukey statistic was applied to the means to pinpoint those differences that were significant (Tukey critical range = 3.22, $p = .01$). The result was that completion times were equivalent for the two conditions during the first half of Annex B, but that cooperative learning groups took significantly more time during the second half of Annex B and during Annexes C and F. Near the end of the course, this trend was reversed. Cooperative learning groups were taking significantly less time than individuals to complete PEs during Annex G. This result suggests that at least for a good portion of the course, a group learning method is likely to increase the amount of time that students need to complete PEs.

The increased PE completion times for cooperative learning students did not tend to exceed the scheduled PE periods. Instructors informally reported that very few groups of students ever had to attend study hall to finish a PE. The mean recorded PE times per annex also were consistently below the mean scheduled PE times, as seen in Table 10. It appears, then, that the current training schedule can accommodate any increases in PE completion time that are associated with the group learning approach.

Study Hall Data

Throughout the tryout, instructors kept a record of the number of study hall sessions that were held, the number of students who attended, the number of instructors who monitored each session, and the time length of each session. These records were examined to assess the impact of the cooperative learning approach on the 76C study hall system and, more specifically, to determine whether the study hall requirements associated with cooperative learning were excessive.

Table 11 summarizes the study hall results for the three classes within each learning condition. The most striking result is that the instructors for the traditional classes held more study hall sessions. There were an average of 13.67 sessions for the individual learning classes compared to an average of 6.67 sessions for the cooperative learning classes. The other notable difference is that the cooperative learning study halls generally had more students in attendance than did the individual learning study halls. The precise reason for each student's attendance was not recorded. It can be reasonably assumed, however, that the greater number of cooperative learning students attending study hall was due to the group reward system that was in effect as part of the cooperative learning approach.

Table 11. Study Hall Data

	Learning Condition	
	Cooperative	Individual
Number of Sessions		
Class 1	6	10
Class 2	6	16
Class 3	8	15
(Mean)	(6.67)	(13.67)
Mean Number of Students per Session		
Class 1	18.50	13.80
Class 2	17.67	7.44
Class 3	8.13	4.47
(Mean)	(14.77)	(8.57)
Mean Number of Hours per Student		
Class 1	4.44	4.70
Class 2	3.68	4.33
Class 3	2.44	2.58

(Mean)	3.61	3.93
Mean Number of Instructors per Session		
Class 1	1.33	1.70
Class 2	1.67	1.81
Class 3	1.88	1.07
(Mean)	(1.63)	(1.53)
Total Number of Instructor Hours		
Class 1	15.83	25.50
Class 2	15.25	46.50
Class 3	22.50	24.00
(Mean)	(17.86)	(32.00)
Mean Number of Minutes per Session		
Class 1	103.33	90.00
Class 2	92.50	95.63
Class 3	90.00	90.00
(Mean)	(95.28)	(91.88)

The number of minutes devoted to each study hall session and the instructor staffing requirements per session were about the same for the two conditions. However, because of the larger number of sessions held by the control group instructors, the total number of hours that instructors spent monitoring study halls was substantially greater for the control condition. The average number of study hall hours per student was also slightly higher under individual learning due to the larger number of sessions associated with this condition. Taken together, the study hall results suggest that the cooperative learning technique did not strain the 76C study hall system. The increase in study hall sessions for the control group was unexpected and may have been due to a choice by instructors to provide their students extra training opportunities.

Annex H Preference Data

The Annex H preference data consisted of the votes cast by cooperative learning students for working either individually or in groups on the Annex H comprehensive PE. The result was that in all three

cooperative learning classrooms, an overwhelming majority of students expressed a preference for group work. The actual numbers for each class are given in Table 12. The data combined for all three classes (N=126) shows that 92% preferred group work and that 8% preferred individual work. Thus, it appears that most students like the cooperative learning approach.

Table 12. Number of Cooperative Learning Students Preferring Group Versus Individual Work on the Annex H Comprehensive PE

Cooperative Learning Class	Preference	
	Group Work	Individual Work
Class 1	48 (96%)	2 (4%)
Class 2	37 (95%)	2 (5%)
Class 3	31 (84%)	6 (16%)
Overall	116 (92%)	10 (8%)

In response to the votes, cooperative learning was implemented during Annex H in all three of the classrooms. Performance data were not collected, however, due to the excessive amount of time that would have been required to score and record errors for a PE of this nature.

Student Questionnaire Responses

A copy of the informal student questionnaire that was used to gather information about students' perceptions and attitudes about cooperative learning can be found in Appendix B. The questionnaire results indicated that most of the students who participated in cooperative learning liked the technique and preferred working on PEs in groups rather than individually. When asked what they liked most about group learning, the

most frequent answer was the help and information gained from peers. The following were typical comments: "(I liked) the advantage of getting help within the group without waiting in line to see the instructor"; "When I could not see material presented on the projector, I could count on my team members to inform me". Students also liked the opportunity to help others and to work as part of a team. About one third offered comments such as, "Everyone pulls together as a team"; "(I like) being able to assist others". Other students noted the opportunity to participate in group discussions and the reduction in stress as the most-liked aspects of cooperative learning.

When asked what they disliked about cooperative learning, many mentioned the group study hall requirement. The next most common response was that students who were tempted to let others do the work did not learn the material themselves. Group arguments, the inability of peers to provide effective help, a lack of discipline in the groups, and the frustrations of fast students were also cited as dislikes of the approach.

The responses to questionnaire items about study hall revealed that a majority of the students either felt neutral about or liked going to study hall in general. However, students liked study hall less when the only purpose was to help group members. More than one third expressed dislike or strong dislike for study hall attendance when it was a group requirement.

Finally, when asked about the extent to which group cooperation had actually been achieved, most of the students reported that their group always or usually functioned as a team. A majority also reported that members never or hardly ever caused problems or failed to contribute their fair share. These data are consistent with informal classroom observations and suggest that a cooperative approach to solving PEs had been implemented most of the time.

Instructor Questionnaire Responses

An informal instructor questionnaire (shown in Appendix B) provided some information about instructors' reactions to cooperative learning as an instructional technique. In general, the instructors expressed a positive attitude toward the group learning approach. A majority of the instructors stated that they would choose to implement group learning in a future course and that, in their opinion, group learning promoted better learning and positive student attitudes. The most common perceived advantage to be gained by a cooperative learning approach was that students learned how to work with others. Better learning, reduced instructor burden, and leadership opportunities for students were also cited as advantages of the new technique.

On the negative side, most of the instructors believed that cooperative learning provided an opportunity for weak, unmotivated students to rely on others for PE solutions rather than learning the material themselves. Several other comments related to the need for instructors to identify weak students early in the course, perhaps by requiring individual work initially. Finally, some of their criticisms underscored the need to fully inform instructors and unit commanders ahead of time to gain their full support in implementing the technique.

Discussion and Conclusions

Several conclusions can be drawn from the results of the tryout of cooperative learning. One striking result that emerged from the performance data was the finding that cooperative learning classes experienced an academic recycle rate that was less than half of that experienced by classes under the traditional learning approach. There was also some evidence to suggest that the cooperative learning students who were recycled generally were performing at a higher level than were the students who were recycled out of the individual learning classes. It was concluded, therefore, that cooperative learning resulted in increased performance levels among students who tend to perform most poorly in the 76C course.

The lower recycle rate under cooperative learning cannot be explained as a positive impact of group learning on students who have relatively low aptitude. This conclusion is based on two observations. First, recycling bore no relationship to ASVAB clerical aptitude scores in either learning condition. Moreover, when the aptitude scores of recycled students were compared for the two learning conditions, there was no evidence that low aptitude students benefited disproportionately from cooperative learning. The second observation pertains to low-aptitude students who finished the course on schedule. Test performance levels were comparable for the low-aptitude students in the two conditions, indicating once again that group learning did not offer any particular advantage to low-aptitude students.

Since the reduction in academic recycle rate was apparently not due to an improvement in the performance of low-aptitude students, an alternative explanation is needed. It could be that cooperative learning was a motivator for some students. Perhaps peer pressure associated with the group reward system motivated students to avoid performing badly on the exams. Or, since most students indicated that they liked cooperative learning, the technique may simply have been a positive motivator for

succeeding in a course that they felt relatively good about. The reduced academic recycle rate associated with cooperative learning may have been due to one or, more likely, both of these motivational factors.

Although the group learning approach resulted in fewer students being recycled, it did not have an effect on the test performance of students who stayed with the course on schedule. It was therefore concluded that the kind of group learning approach that was employed in this tryout has no observable effect on the learning achievement of most students in the course. This result contradicts the Hagman and Hayes (1986) finding that group learning with group reward leads to superior test performance. However, since in the present tryout group learning was not found to be superior at any point in the course, the weight of the evidence favors the conclusion that cooperative learning has no effect on the test performance of most students.

The test completion time data that were available suggested that cooperative learning initially resulted in slower task performance when students were in a testing situation. Contrary to the earlier Hagman and Hayes (1986) results, students who had been trained under the group learning method generally took more time to complete annex tests than did students who had been trained under the individual learning approach, at least for the first half of the course. Since test completion time data were not available for later annexes, it is not known whether the cooperative learning students were slower on annex tests through the remainder of the course. The EOCT time data did show, however, that cooperative learning students took less time to complete tasks on the final comprehensive exam. One interpretation for this finding is that cooperative learning students may have needed more time at first to adjust to an individual test compared to students who were accustomed to working task situations individually during PEs. However, by the end of the course, students who had studied cooperatively perhaps could approach test situations with greater efficiency and confidence than could students who had studied individually.

With respect to performance on the PEs, the results showed that students working in groups made consistently fewer errors than did students who worked individually. This finding, which corroborates a result reported by Hagman and Hayes (1986), indicates that cooperative learning does improve the overall quality of PE work. The data also showed that the lower PE error rate was often accompanied by an increase in the amount of time needed to complete PEs in a group setting. For about the first half of the course, cooperative learning students required relatively longer periods of time to complete PEs. A shift in this trend eventually occurred, however, such that groups were actually faster than

individuals during the last annex. On the basis of these data, it was concluded that cooperative learning can be expected to first increase, then decrease the amount of time required for PE work. It appears that the group strategy that results in higher-quality PE products also becomes more efficient over time as students gain experience working in groups.

Although an effort had been made to reduce competition among instructor teams, the study hall data suggested that instructors for the individual learning classes may have been using study hall periods to supplement training time. The greater number of study hall sessions and the proportionately greater number of student hours spent in study hall for the control condition raises the question of whether any benefits due to cooperative learning were masked by this difference in training time. The conclusion that cooperative learning does not improve the test performance of most students in the course is indeed a conservative one when the study hall data are also considered.

The most important finding that emerged from the study hall data is that group PE work and group rewards did not lead to an unmanageable increase in study hall attendance. Although cooperative learning resulted in an increase in the number of students attending per session, the increase was a modest one that, to our knowledge, did not pose any scheduling problems. Most of this increase was due to the group reward system rather than to the groups' need for additional time to complete PE work. Because the increase was slight, it was concluded that the cooperative learning technique with a group reward system of study hall attendance can be implemented in the 76C course without disrupting established school practices and schedules.

Cooperative learning also appears to be a technique that is liked by most students and instructors. From the attitude and opinion data, it was concluded that students and instructors would probably support cooperative learning as a permanent modification to the 76C course. Most students stated that they liked group work and preferred it to individual PE work, primarily because the group offered additional help and information. Instructors, while somewhat less enthusiastic, also indicated an overall preference for implementing the cooperative learning technique in the course. In their judgement, group learning was a valuable tool for training students how to work with others in a job environment.

When the tryout data are considered as a whole, they provide valuable information about the potential costs and benefits of implementing cooperative learning in the 76C course. First, the implementation costs have been shown to be minimal. Because very little special training is required, instructors and students can be fully introduced to the method

in as little as one or two hours. The only other observed cost was a slight increase in the amount of time that students needed to complete PEs and tests. Even this increase was so slight, however, that it did not interfere with the regular class schedule. While the number of students going to each study hall increased with cooperative learning, the overall number of student hours spent in study hall was actually less under this approach compared to the traditional training approach. There are no equipment, materials, or other monetary costs associated with cooperative learning as it was employed in the tryout.

On the other hand, the benefits that can be gained from cooperative learning are significant. The observed reduction in the student recycle rate by more than half translates directly into dollar savings for the Quartermaster School. In view of the tryout recycle data, the potential cost savings is estimated to be as high as \$136,500 per year (see Table 13). Furthermore, the performance time data indicate that, at the end of the course, cooperative learning students perform job tasks more efficiently than do students who have been trained with the traditional method. Finally, there are the less tangible but important benefits of an increased ability to work well with others and higher soldier morale. In sum, the data indicate that the benefits of a cooperative learning instructional method probably outweigh its costs.

Table 13. Cost Implications of Reduced Recycle Rate*

Traditional Instruction Recycle Rate	10.9%
Cooperative Learning Recycle Rate	4.4%
Savings	6.5%
Number of Students per Year	3,000
Cost per Student	\$7,000
Length of Course	10 weeks
Length of Average Recycle	1 week

$$\begin{aligned}
 \text{Cost Savings} &= (\text{Reduction in recycle rate}) \times \\
 &\quad (\text{Proportion of course recycled}) \times \\
 &\quad (\text{Number of Students per year}) \times \\
 &\quad (\text{Cost per student}) \\
 &= (.065) \times (0.1) \times (3,000) \times (\$7,000) \\
 &= \$136,500
 \end{aligned}$$

*Note: The values used in the computation are estimates.

The tryout results also suggest procedural modifications that ought to be considered in future implementations of cooperative learning. One suggested change is to identify and try out an alternative form of group incentive to replace the current use of study hall as punishment to be avoided. In the current scheme, the "reward" for successful performance is to advance to new material and therefore avoid remedial study hall. However, since a majority of the students in the tryout stated on the questionnaire that they either felt neutral about or liked going to study hall to help group members, it cannot be assumed that study hall is a negative consequence of exam failure. Moreover, the decision to use study hall avoidance rather than a positive reinforcer was driven only by the practical constraints of the research setting. Possible alternatives that might be used as positive rewards in lieu of the current study hall mechanism include free time, privileges, and special recognition.

In terms of future research directions, a controlled evaluation could provide an objective basis for choosing among different kinds of incentives. Moreover, the research results would indicate whether there is an alternative low-cost form of reward that boosts the effectiveness of group learning for improving soldier achievement. Along these lines, an interesting possibility is the use of between-group competition. There is very little published research that has compared cooperative learning without intergroup competition to cooperative learning with intergroup competition. At present, the evidence suggests that cooperation without group competition results in higher achievement (see Johnson, Maruyama, Johnson, Nelson, & Skon, 1981). To our knowledge, however, this question has not been addressed in a military training environment, for which the result may be quite different. At the least, an evaluation of cooperative learning with intergroup competition has potential payoffs in terms of achievement while incurring relatively little cost.

Another procedural modification suggested by the data is to improve communication and coordination with unit commanders, instructors, and any other school personnel who are affected by scheduling changes or other procedural changes that are brought about by cooperative learning. For example, if group study hall were to continue as part of the cooperative learning approach, the support of personnel at the company and/or brigade level needs to be secured. During the tryout, instructors indicated that a requirement for study hall attendance was sometimes not met due to scheduling conflicts and the reluctance of unit personnel to release students. Although the tryout did not address this issue directly, future implementation efforts need to involve unit personnel with the goal of identifying legitimate problems and their solutions.

Another example of the need for improved communication is the reaction by some instructors that group work conflicts with the need to maintain a military, disciplined atmosphere in the classroom. Some questionnaire responses and classroom observations revealed that the informality and the noise levels associated with group work were unwelcomed changes to classroom conduct. An exchange of ideas between instructors and school administrators on this and other concerns related to cooperative learning is a possible avenue for increasing the level of enthusiasm that instructors bring to a cooperative learning implementation. Taking the time to fully communicate the results of the tryout to instructors is strongly suggested. The bottom line is that genuine instructor support for this or any new technique is critical to its success.

A final type of procedural modification to consider has to do with the need for all group members to take responsibility for their own learning. During the tryout, several students and instructors expressed the view that students often copy PE work to avoid doing the work themselves. One possible solution is for instructors to emphasize the learning of PE material and to deemphasize PE error scores. A shift in emphasis from PE scores to PE understanding will be greatly facilitated by the elimination of the PE data recording procedures that occurred during the tryout. The scoring and recording of PE errors are not part of the cooperative learning approach per se and serve data collection purposes only. If instructors still wish to score the PEs for information and feedback purposes, they should do so without assigning and recording total error scores. This simple change may reduce the tendency of some students to achieve high PE scores at the expense of understanding job tasks.

Probably a more productive avenue to pursue is the use of specific group learning strategies. Future research in this area could compare the current unstructured group approach with one or more approaches that impose a group interaction strategy. One example of an imposed strategy is to assign a leadership role to individual group members on a rotating basis. If each individual group member takes charge of the group at regular intervals (e.g., one day a week), the tendency of the weakest students to rely on others may be reduced as their own participation increases. Another strategy to promote the participation of all group members might be to require individual PE work prior to getting together as a group to discuss and agree upon the solution.

The cooperative learning literature offers some evidence that the use of specific strategies can facilitate group learning. For example, Dansereau and his colleagues (Dansereau, 1983; McDonald, Larson,

Dansereau, & Spurlin, 1985; Spurlin, Dansereau, Larson, & Brooks, 1984) have shown that pairs of students studying cooperatively have higher recall of to-be-learned material when one member of the pair is assigned the role of recaller and the other is assigned the role of listener who provides corrective feedback and elaboration. Webb (1984) has also shown that learners who are left to their own group interaction strategies do not always choose the types of interactions that facilitate learning. An important role for future research efforts would be to identify the kinds of cooperative learning strategies that are most effective for supply tasks.

One final point of discussion pertains to the role of cooperative learning in a computer-based training environment. For several reasons suggested by the tryout results, it seems advisable to implement a cooperative learning approach on at least an experimental basis in the computerized classroom. The first reason pertains to the fact that students and instructors both like the group learning concept. The concept of cooperative learning with its key elements of small group size, teamwork, individual testing, and group reward does not change as computers become the vehicle for instruction. Second, there is no evidence that 76C students perform worse on the course material as a result of having worked PEs in groups. The evidence suggests to the contrary that the cooperative learning approach may reduce recycling because of its motivational qualities. Third, the school stands to realize a substantial cost savings if one computer terminal can effectively support the learning of more than one student simultaneously.

Published research findings also suggest that computer-assisted cooperative learning is a potentially cost-efficient training approach. At least two studies have investigated the feasibility of cooperative learning methods for computer-based training of military skills. Dossett and Hulvershorn (1983) compared conventional classroom instruction, computer-based individual instruction, and computer-based cooperative instruction for training electronics principles to Air Force trainees. The three approaches resulted in equivalent achievement as measured by course tests. Moreover, student pairs who had studied cooperatively with computer-based materials required significantly less time to train than students in either of the other two conditions. Shlechter (1987) has provided recent evidence for the cost efficiency of group computer-based instruction with armor noncommissioned officers. In addition, research with college students has suggested that cooperative methods in a computer-based training environment are feasible and potentially cost effective for instruction in mathematics (Reid, Palmer, Whitlock, & Jones, 1973; Sutter & Reid, 1969), simple text-processing strategies (Dansereau, Rocklin, O'Donnell, Hythecker, Larson, & Lambiotte, 1984), and concept learning (Carrier & Sales, 1987).

However, in this important area of concern to the Quartermaster School, there are several questions yet to be empirically addressed. One is whether the achievement of students who share a computer is different from the achievement of students who work at the computer alone for the types of tasks taught in the 76C course. Different group sizes should also be included in a formal evaluation to determine an optimum student-to-terminal ratio for the computers and courseware used in this course. Another research question is whether any differences in achievement performance between groups and individuals in a computer-based training environment depend on the characteristics of the students who are grouped together. Previous studies, for example, have shown that factors such as ability (Morrison, 1984), dominance, and sociability (Sutter & Reid, 1969) can affect the achievement levels attained by student pairs learning from computer-based materials. Future research might address the importance of these student attributes when grouping 76C students for computer work. Finally, research will be needed to determine the nature of the material that is best suited for computer-based group learning. For example, it may be useful to develop and evaluate computer-based materials that include embedded strategies to structure the group interaction. Answers to these types of questions will be needed to make the most of the potential advantages to be gained from group learning as computer-based instruction is implemented in the 76C course.

FOOTNOTES

1. The term "double class" refers to two separate classes that begin the course on the same date and run concurrently.
2. Two classes were considered a pair if they started the course on the same date or if they started within a week of each other. There were two pairs of double classes (same start date) and one pair of classes that were only a week apart.
3. These figures do not include students who recycled into the course at any point in time nor students who dropped out of the course prior to the start of Annex B.
4. This relatively stringent criterion was chosen because of the large sample size in Phase 2.
5. The research clearly suggests that individual accountability should be maintained as part of the cooperative learning approach if intergroup competition is added. Thus, for example, the achievement score for each group would be based on a group average that takes into account every member's score.

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APPENDIX A

76C Course Instructor's Guide for the Cooperative Learning Tryout

Cooperative Learning Tryout: Instructor's Guide

I. Introduction

In the past 15 years there has been a growing interest in the use of cooperative learning methods for enhancing training effectiveness. During cooperative learning, trainees spend a portion of their class time working in small groups where they are expected to help one another learn. This is in contrast to individual learning methods used currently in Army Schools where trainees are expected to learn on their own without help from other trainees.

In 1984, the Army Research Institute (ARI) designed an experiment to determine whether or not cooperative learning will work effectively for training the 76C on Manual PLL procedures. This experiment stressed the team concept and encouraged trainees to "take charge" and assume responsibility for not only their own learning but also the learning of others. The results provided evidence that learning in groups successfully enhanced trainees' knowledge.

The current project is a tryout of cooperative learning to determine if learning in groups can be successfully used throughout most of the 9-week, 4-day course, not just in B Annex. It is hoped that in the long run, cooperative learning will be an effective, low-cost means of improving student achievement in the 76C course. This tryout will help verify the potential benefits and costs of implementing a cooperative learning approach.

The tryout will make the Quartermaster School special and will distinguish it as a model for other training schools. Your help, patience, and cooperation will make the project proceed smoothly. As instructors, you are not to change your basic style of teaching. However, because you are part of this special project, you will have additional responsibilities. For one, instructors in the cooperative learning classroom will form students into groups to complete PE assignments. The other major responsibility is that instructors for both the traditional and the cooperative classrooms will be collecting detailed data and recording it on special data collection forms.

Instructors are not being evaluated during this tryout. The objective is to find out if a certain method can help the trainees do what they are expected to do better. ARI researchers (Judith Brooks, Richard Thoreson, Douglas Dressel, and Stephen Cormier) will be on hand at least part of the time to assist you and answer your questions. If at any time you have a question about the project and no researchers are readily available, please contact Mr. Thayer. Any and all questions, concerns, and suggestions will be appreciated.

The purpose of this guide is to provide a general overview of the tryout and a detailed description of the specific steps that need to be performed by the instructor to ensure valid and meaningful results.

II. Overview of the Tryout

The tryout will evaluate the effectiveness of cooperative learning for improving student achievement over a longer training period than what has thus far been examined. A cooperative learning method will be implemented in designated 76C classes throughout most of the course. Students who study cooperatively for part of the classroom time will be compared with students in a control condition who follow the typical classroom procedure of studying individually.

Comparisons between the two groups of students on measures of achievement test and PE performance will permit a preliminary evaluation of the relative effectiveness of cooperative learning for improving 76C course instruction. Other data to be collected will provide information about certain practical implications, such as changes in study hall manpower requirements, that may be associated with implementation of this new technique.

a. Annex A (AMDF)

Cooperative learning procedures will NOT be implemented during the practical exercises of A Annex due to the special equipment needs associated with that annex. However, upon entering A Annex, students in the designated cooperative learning class will be told that cooperative learning begins in B Annex, and student groups will be identified. These identified groups are the same groups that will work together on B Annex PE's.

The major responsibility of AMDF instructors assigned to the cooperative learning class is to divide the students into study groups. It is important that the groups be formed such that the students within a group vary in terms of their overall classroom performance. That is, it is important to have a balance of good, average, and weak students in each group. Avoid having groups comprised of all weak or of all exceptional students.

By no later than the third day of A Annex, groups will be identified, and students will be told which group they belong to. The AMDF instructors should also encourage students to get to know their group members and will facilitate this process by seating group members near one another. The AMDF instructors are not required to record any special data (other than group membership) or to implement any new instructional procedures in connection with this project.

b. Annex B - Annex I (PLL Manual - End of Course Test)

Cooperative learning procedures and data gathering will begin in B Annex and continue through most of the course. For instructors in the cooperative learning classroom, the project will mean implementing group

learning procedures in the classroom and maintaining detailed data records. For instructors in the traditional learning classroom, the only special requirement will be to maintain detailed data records.

c. Annex H (Comprehensive Performance Exercise)

Annex H is somewhat special in nature and will be treated differently from Annexes B, C, D, E, F, and G. At the beginning of H Annex, all individual trainees will be given a chance to indicate their preference for either working individually or with their group on the comprehensive exercise. This will be done by confidential voting. The votes will be tallied by separate groups to determine whether a given group remains intact for the PE or whether the group is disbanded.

For example, if 3 members of a 4-member group vote to work as a group, all 4 members will work together during H Annex. In the case of a tie vote, the group will be disbanded, with members working individually. That is, if Group C has 4 members, and 2 vote "group" while 2 vote "individual", the "individual" vote will rule. For any given group, there must be a majority in favor of group learning in order to maintain the group procedure during H Annex.

ARI researchers will assist with the voting process and will provide ballots. The instructors will have no special requirements during H Annex. The number of errors that students make and the completion times DO NOT have to be recorded for H Annex.

The remainder of this section on the tryout "overview" covers 4 critical concepts associated with the tryout. Once these general concepts have been presented, Sections III and IV will detail the specific steps to be followed in the classroom.

1. Practical Exercises and Comprehensive Practical Exercises

The tryout calls for cooperative learning to take place during the practical exercises (PE's) and the comprehensive practical exercises (CPE's) of the 76C Program of Instruction (POI), beginning with B Annex. During A Annex, each class that has been assigned to the cooperative learning condition will have been divided into separate study groups. To the extent possible, the composition of these groups is to remain intact as students leave A Annex and continue on with the course.

While working on the PE's, each group is to arrive at its answer by agreement, such that only one answer per question is provided by the group. Each group member however, is to fill out his or her own PE booklet. This will ensure that all group members will share the same answer to the PE questions. Each PE is to be scored for both speed (time to completion) and accuracy (number of errors). A data book is being provided for the purpose of recording this data.

Each PE booklet will have start and stop time requirements to be filled out by the trainee. All trainees will compute total PE times in

minutes for both in-class and study hall periods (if they occur). The instructor should monitor all the booklets to assure that completion time has been recorded and that total time used has been correctly computed. The instructors should announce to the class the beginning time to be recorded on the PE booklet at the start of the PE. Table 1 shows the stamp that will appear on the front of each PE booklet for recording and computing these times. NOTE THAT PE'S AND CPE'S NOT FINISHED DURING THE ALLOTTED CLASS TIME WILL BE FINISHED IN STUDY HALL.

TABLE 1

In-Class

Stop Time _____

-Start Time _____

(result) ____ hrs. ____ min. = ____ min.

Study Hall

Stop Time _____

-Start Time _____

(result) ____ hrs. ____ min. = ____ min.

TOTAL = ____ min.

2. Testing

All testing is to be done on an individual basis. Students in the group learning class must complete their own tests without help from the other members of the group. Tests are to be scored for accuracy and speed.

The test score (percent correct) and the number of minutes required to complete the test are to be recorded in the same data book in which the PE data are recorded. At exam time, instructors should inform the testing team about the need to record the start and stop time for each individual student. The total number of minutes can be noted directly on the test booklets and later copied in the data book.

3. Reward Condition

"Reward condition" simply refers to the requirement to attend study hall. In the traditional classroom, a student will attend study hall only

if his or her own individual performance is unsatisfactory (for example, if the student fails an end-of-annex test). This type of reward condition is termed "individual reward". Note that the "positive" reward in this case is to proceed on in the course without having to go to study hall. If the individual's test performance is satisfactory, the individual may proceed.

In the cooperative learning classroom, students will be rewarded (allowed to proceed without study hall) as a group. For example, if all 4 members of a group pass the test, all 4 may go on to the new material without having to attend remedial study hall. However, if even 1 member fails the test, all 4 members must return to study hall with the failing member to help him or her study for the retest. That is, the reward of going on without study hall will occur for the study group only if all 4 individuals perform successfully on the test. It is therefore in the best interest of group members to interact during the PE's so that everyone learns the PE material and is capable of passing the tests.

Group reward will apply only up to the point of annex retesting. For example, although the entire group may be required to attend study hall prior to the retest, only the failing individual(s) will be required to actually take the retest. Also, if a student fails a retest, only that failing individual will be recycled. The passing members will have lost a group member but are otherwise not affected. That is, the passing students are not required to engage in further remedial studying for that test.

4. Study Hall Attendance

A major purpose of the tryout is to assess the impact of cooperative learning on study hall space, staffing, and time requirements. In order to make a reasonable comparison between the cooperative and traditional learning classes, certain criteria for study hall attendance must be adhered to by both teams of instructors.

The following criteria and guidelines for study hall attendance have been established for the COOPERATIVE LEARNING CLASS:

- Groups who do not complete a PE or CPE within the allotted classroom time must attend study hall to finish the exercise.
- If any individual fails an exam with a score below 85, that individual plus all of the members of his or her group must attend study hall prior to the retest.
- Groups who have difficulty with a particular block of instruction as reflected in unusually poor PE performance may be required to attend study hall at the instructor's discretion.

The following criteria and guidelines for study hall attendance have been established for the INDIVIDUAL LEARNING CLASS:

- Individuals who do not complete a PE or CPE within the allotted classroom time must attend study hall to finish the exercise.
- Individuals who fail an exam with a score below 85 must attend study hall prior to the retest.
- Individuals who have difficulty with a particular block of instruction as reflected in unusually poor PE performance may be required to attend study hall at the instructor's discretion.

A study hall log book is being provided for recording the number of instructors, the number of students, and the number of minutes associated with each day's study hall period.

III. Specific Steps to follow for the COOPERATIVE LEARNING CLASSES

1. Assign Trainees to Groups

By the third day of A Annex, trainees are to be assigned to groups consisting of either 3, 4, or 5 members. The group size to use for a specific class will be made by making the maximum number of 4's. Check Table 2 for group number make-up.

Table 2

CLASS SIZE	Numbers of groups of each size		
	4s	5s	3s
35	8		1
36	9		
37	8	1	
38	8		2
39	9		1
40	10		
41	9	1	
42	9		2
43	10		1
44	11		
45	10	1	
46	10		2
47	11		1
48	12		
49	11	1	
50	11		2
51	12		1
52	13		
53	12	1	
54	12		2
55	13		1

Note that if a class is scheduled to be divided into 4-member groups and the number of trainees is not equally divisible by 4, it is then all right for groups to have 3 or 5 members, but not less than 3. For example, for a class of 50, there would be 11 groups of 4 and 2 groups of 3 members.

An important objective of the grouping process is to form study groups that have a roughly equal mixture of strong and weak students. There are 2 reasonable ways to achieve the goal of "balanced" groups. One way is to randomly assign students into groups in alphabetical fashion by blocking off names on the roster. By chance, students of varying ability and motivational levels should be evenly distributed over groups. Another way is to rely on one's own judgment as an experienced instructor. Given a short amount of time to observe the class, AMDF instructors may feel confident in forming groups that have a balance of strong and weak students. The method used to form balanced groups will be left up to the AMDF instructors.

Once group membership has been determined, the trainees' names are to be entered in the spaces provided on the data collection forms. For the control classes, no special grouping is necessary. The names can be transferred to the data collection forms exactly as they are found on the class roster.

If a trainee does not proceed to the next annex (for any reason) and a new trainee enters the class, that new trainee will be placed in the group that has just lost a member. If a person enters the class and no one has left a group, the new trainee will be placed to form a group of 4 or (second choice) to form a group of 5. The important thing to remember is to maintain a group size of 4 whenever possible and, in any case, to keep within the limits of 3 and 5. Also, the assignment of recycled students to groups should be random to the extent possible. For example, do not group all of the recycles together. It is best to have no more than one recycle assigned to any given group.

Since AMDF instructors will initially group students such that strong and weak students are working together, the groups should be well balanced by the time they enter B Annex. However, if during B Annex (or in later annexes) the instructors feel that one particular group is entirely composed of weak students while another group is composed of all high achievers, it is all right to switch students around to achieve more balanced groups. Because group cohesiveness (and thus group stability) is thought to contribute to the success of cooperative learning, it is recommended that changes in group assignment be kept to a minimum.

If a change in grouping does occur, the timing of the change is critical. DO NOT make grouping changes during the period immediately after an exam and prior to the study hall that occurs just before retest. This would invalidate the group reward structure. Any grouping changes should be made after the retest study hall and prior to the next regular exam.

2. Assign Students to Appropriate Seats

Once group membership has been determined, students should be assigned to seats in a way that will facilitate grouping and that will minimize furniture movement at the start of a PE or CPE. During classroom demonstrations, all students should be seated in rows facing the platform instructor. At the start of a PE or CPE, half of the students should be able to turn their chairs around and be facing the other members of their group. For example, 2 students next to each other in the front row will turn around and face the 2 students directly behind them to form their group of 4. This type of seating arrangement is especially important for the classrooms where Annexes B-G are taught. The seating arrangement is not as critical for A Annex, although even here members of the same group should sit near one another.

3. Assign a Letter Name to Each Group

Once the groups are identified, they are to be assigned a letter name by the instructor for record keeping purposes. Group members should put this letter and their group size on the top left-hand corner of their PE booklet and test forms before filling them out. For example, the first group should be given the letter name "A" the second group "B" and so forth. Those letter names will be entered on the data collection forms to the right of the space for the trainee's name.

4. Instruct Trainees to Work Together on PE's and CPE's

All members within a group are required to arrive at the same answers to PE (and CPE) questions. This means that each member of a 4-member group, for example, will have the same written answers to each question asked in the PE booklet. If students cannot agree, one member must contact the instructor for clarification. Each group is to immediately inform the instructor when it has completed the PE. The times taken for groups to complete the PE are then to be recorded by the instructor in the spaces provided on the data collection form.

When groups are working together on their PE's, encourage them to work as a team so that all group members understand and agree upon all answers. Do not try to impose any formal structure on the groups. For example, do not designate a group leader or otherwise try to control how the group interacts. The informal, unstructured nature of the groups is an important aspect of the tryout.

5. Inform Trainees of How They are to be Tested and Rewarded

Before allowing trainees to begin working on the PE's, they are to be told how they will be tested. That is, each group member is to take the tests individually (not as a group the way PE's were). They are also to be told about the group reward structure.

6. Allow Trainees to Complete the PE's

Once steps 1-5 have been completed, trainees are to begin the PE's at their normally scheduled times. PE's are to be done in groups, with each group given no more than the scheduled amount of time to complete each PE. Trainees should write start and stop times on the PE booklet and convert time to minutes. Once a PE is completed, the instructor is to record the completion time and the number of errors committed by each group (See section below on scoring to determine how completion times and errors are to be recorded on the data collection forms). Instructors will collect any uncompleted PE's, and trainees will finish them in study hall. Additional time used will be marked on the PE booklet and then recorded by the instructor.

It is anticipated that trainees using cooperative learning may take more time to complete the PE's than will students who work individually. An important objective of this tryout is therefore to determine whether and how much extra study hall time may be needed by cooperative learning students. The study hall log book will be used to record daily study hall requirements.

7. Allow Trainees to Take the Tests

Trainees are to take the tests at normally scheduled times. All testing is to be done on an individual basis with no group interaction allowed. Thus, each trainee will have his or her own answers to the test questions. Tests are to be scored in terms of both time to completion and percent correct (See scoring section below for procedures). We are primarily interested in the first test score for each trainee. The scores for any retests should be put in parentheses in the comments section of the data collection forms. The trainees should mark start and stop times on the answer sheet and compute time taken in minutes.

8. Scoring

PE's (and CPE's) are to be scored in terms of completion time and errors committed. To ease instructor load, trainees may score the PE's for errors during the follow-up critique normally performed by the instructor. Trainee scoring is ok for purposes of the tryout as long as trainees do not score their own PE's or those of any member in their own group. One suggestion on how to do this would be to distribute the completed PE's to others in the class. After each PE has been corrected, it is to be returned to the instructors so that they can enter the error scores on the data collection forms.

If trainees are allowed to score PE's, then they are to be instructed to indicate clearly with a check mark where the error(s) was made. This is to allow ARI to examine the scoring for accuracy. Trainees are to determine their own completion time for each PE. This is done by writing start and stop times on the PE and calculating the completion time down to the minute. The total amount of time taken to complete a PE and the number of errors committed are the scores entered by the instructor in the spaces provided on the data collection forms.

Tests are to be scored only by the ESD testing team, and all test grading will be reviewed by a designated supervisor for grading consistency. For tests, the score to be recorded on the data form is the student's grade in terms of percent correct. Time to complete the test is also to be recorded. Spaces for these data are provided on the data collection forms. Only first test data are to be recorded in the columns provided on the data collection forms. If a trainee has to retest in order to pass the annex, the retest time and score should be put in parentheses in the comments column of the data collection form. The comments column may also be used to briefly designate whether the student was dropped or recycled and why.

Data from the Annex I end-of-course test is also to be recorded on a separate form. Use the form provided to record the Part A, Part B, and composite test score, as well as the time required to complete Parts A and B.

9. Have Trainees fill out Questionnaire

After the class has completed the entire course, the instructor will be asked to distribute a questionnaire to each trainee. Instructors will be given specific guidance when the questionnaire has been finalized.

10. Data Collection Forms

Data collection forms have been developed for each class participating in the experiment. Learning Condition (Group or Individual) is indicated in the upper left-hand corner of the forms. Each form contains spaces for recording the trainee's name, social security number, group letter name, errors (or scores) and completion times for PE's, CPE's, and tests, and columns for comments. The forms will be passed out to the instructors before the start of the Manual PLL Annex.

The data collection forms will have as much information on them as possible. We will try to place trainee names and social security numbers on the forms prior to the start of the tryout. Most of the information required on the data collection forms is self explanatory.

The number of errors made on the PE's will be placed under the proper column. Next to each trainee's PE error, total the amount of time (minutes) it took the group or individual to complete the PE. The test column will have the percent correct grade for the annex test. The comments column will be used by the instructors to place retesting scores (in parentheses) for trainees that failed the initial test.

IV. Specific Steps to Follow for the INDIVIDUAL LEARNING CLASSES

1. DO NOT form students into study groups. As an instructor for the individual learning classroom, the major requirement you have that is different from ordinary practice is to keep detailed data records.

2. For each PE (or CPE), record the number of errors and the total time required to complete the PE. If any student cannot complete the PE in the allotted class time, require the student to complete the work in study hall. Be sure that students in this class are doing the work by themselves.

3. Tests are to be administered in the usual fashion, with the exception of keeping track of the time the test required. Students will complete tests individually. The time required by each student to complete the test and the test score are to be recorded on the provided data form. This applies to all end-of-annex tests and to the end-of-course test (Annex I).

4. For details pertaining to scoring and data collection forms, see steps 7-10 of the preceding section.

APPENDIX B

Student and Instructor Questionnaires Used to Determine Attitudes and
Perceptions Concerning Cooperative Learning

COOPERATIVE LEARNING STUDENT QUESTIONNAIRE

The Army Research Institute is trying out and evaluating group learning (or cooperative learning) as one possible way to help students learn the 76C course material better. The purpose of this questionnaire is to find out your reactions to the group learning procedures that were used in this course. Please give honest answers to the questions below. This questionnaire is strictly voluntary and anonymous.

Based on your experience in the 76C course, which of the following terms best describes how you honestly feel about group learning? Circle one:

STRONGLY DISLIKE DISLIKE NEUTRAL LIKE STRONGLY LIKE

If you had it to do over again, would you prefer to work as an individual or in a group on the PE's? (Check one):

- _____ 1. I would prefer to work individually.
_____ 2. I would prefer to work in a group.

What I LIKED the most about group learning was:

What I DISLIKED the most about group learning was:

HOW DO YOU FEEL ABOUT:	(Circle your response)				
	STRONGLY DISLIKE	DISLIKE	NEUTRAL	LIKE	STRONGLY LIKE
Helping Others In The Group	X	X	X	X	X
Doing PE's In A Group	X	X	X	X	X
Your Groupmates	X	X	X	X	X
Your Classmates	X	X	X	X	X
Going To Study Hall To Help Your Groupmates, Even When Your Own Test Scores Are Satisfactory	X	X	X	X	X
Going to Study Hall In General	X	X	X	X	X
Group Learning In Any Future Course	X	X	X	X	X

HOW EASY OR DIFFICULT WAS IT FOR YOU TO:

	QUITE EASY	FAIRLY EASY	BORDERLINE	FAIRLY DIFFICULT	QUITE DIFFICULT
Get Your Work Done In A Group	X	X	X	X	X
Make Friends In Your Group	X	X	X	X	X
Learn In Your Group	X	X	X	X	X
Do PE's In Your Group	X	X	X	X	X
Understand Explanations By Groupmates	X	X	X	X	X
Stay Friends With Groupmates	X	X	X	X	X

At what point during this course did you feel best about learning in a group? Check one:

_____ BEGINNING _____ MIDDLE _____ END _____ NEVER

To what extent do you think your group members worked together as a team? Check one:

_____ Always worked as a team _____ Usually Worked as a team _____ Sometimes Worked as a team _____ Hardly Ever Worked as a team _____ Never Worked as a team

During group learning, how often did you observe group members deliberately causing problems or failing to contribute their fair share? Check one:

_____ Always _____ Usually _____ Sometimes _____ Hardly Ever _____ Never

CHECK ALL THE THINGS YOUR GROUP DID TOGETHER:

_____ Helped each other outside of class

_____ Competed on tests and PE's with:

_____ Each other in the group

_____ Groups in the same class

_____ Trainees in other classes

_____ Went places as a group during your free time

_____ Gave your group a name (other than its letter name)

While working together in your group, which strategy did the group adopt for completing the PE's/CPE's?

_____ As a group, complete each problem together.

_____ As an individual, complete a problem, then discuss it with the group before going on to the next problem.

_____ As an individual, complete the entire PE/CPE, then discuss it with the group.

_____ Ask for group help only when needed.

_____ Other: Please list any other methods your group used during the PE's or CPE's.

Did your group study method change during the course?

_____ Yes _____ No

Did your group study method change when new members were added to the group?

_____ Yes _____ No

If you have any other comments concerning cooperative learning, please write them here:

Thank you!

COOPERATIVE LEARNING INSTRUCTOR QUESTIONNAIRE

The purpose of this questionnaire is to help ARI evaluate and improve upon cooperative learning as an instructional technique for the 76C course. Please answers all questions. The suggestions, ideas and feedback that we receive from you and other instructors who have actually tried this technique in the classroom will play an important role in shaping our recommendations regarding cooperative learning.

1. If you were an instructor for an incoming 76C class and had to choose between group learning as it was conducted in this course and individual learning as normally conducted, which approach would you choose? (Check one)

_____ Individual learning, with no student grouping

_____ Cooperative (group) learning

2. In your opinion, did group learning promote better learning of the course material? (Check one)

_____ Yes

_____ No

3. In your opinion, did group learning help promote a positive attitude on the part of students toward the course? (Check one)

_____ Yes

_____ No

4. One of the goals of cooperative learning is to encourage students to teach one another and to assume responsibility for how well their group members learn. We are therefore interested in your perceptions regarding the impact of cooperative learning on your teaching burden. Please indicate with a checkmark whether you think your burden as an instructor

_____ increased

_____ reduce

_____ stayed the same

as a result of this approach.

5. What, if any, is the most important advantage to be gained from implementing cooperative learning in the 76C course?

6. What, if any, is the most serious problem that you see with regard to cooperative learning as it was conducted in the course?

7. If you have any other comments concerning cooperative learning, please write them here:

Thank you!